

A NEW CAVE SPECIES OF THE GENUS GAMMARUS (CRUSTACEA, AMPHIPODA, GAMMARIDAE) FROM SICHUAN, CHINA

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Abstract A new cave *Gammarus* species, *Gammarus praecipuus* sp. nov., from Sichuan, China, is described. This new species can be distinguished from other *Gammarus* species by eyes absent; the outer plate of maxilla 1 with 31 robust serrated apical spines, distinctly more than common *Gammarus* species with 11 spines; both rami of uropod 1 bare; and inner ramus of uropod 3 reaching 0.5 times the length of outer ramus. Type specimens are deposited in the Institute of Zoology, Chinese Academy of Sciences (IZCAS), Beijing.

Key words Taxonomy, SEM, comparison, Southwest China.

1 Introduction

Cave ecosystems have been considered natural laboratories for evolutionary researches because of the relative simplicity and the spatial isolation. Thus, cave animals have attracted the attention of biologists in understanding evolution related to biogeography and speciation in a similar manner to island fauna (Juan *et al.*, 2010; Lin *et al.*, 2012). Amphipoda crustaceans are the predominant macroscopic invertebrate in aquatic subterranean habitats, including more than 800 species in 133 genera of 35 families (Culver and Pipan, 2009). However, there are only 15 cave-dwelling species have been recorded in China, belonging to 5 genera in 3 families (Hou and Li, 2009). The genera *Pseudocrangonyx* and *Procangonyx*, with 4 species, are endemic to East Asia; while the genus *Bogidiella* is worldwide distributed in interstitial regions, and only one species was reported in China. The genus *Sinogammarus* with 2 species are found in Southwest China, which was proved to be a junior synonym of *Gammarus* (Hou *et al.*, 2007). The other 8 cave species are attributed to the genus *Gammarus* as follows: *G. aoculus* Hou *et al.*, 2003; *G. xianfengensis* Hou *et al.*, 2002; *G. lichuanensis* Hou *et al.*, 2002; *G. glabratus* Hou *et al.*, 2003; *G. platvoeti* Hou *et al.*, 2003; *G. translucidus* Hou, Li *et al.*, 2004; *G. comosus* Hou, Li *et al.*, 2005, and *G. abstrusus* Hou, Platvoet *et al.*, 2006. The present paper deals with the ninth new *Gammarus* species from a cave in Sichuan Province, China.

2 Material and Methods

The specimens used in this study are deposited in the Institute of Zoology, Chinese Academy of Sciences (IZCAS), Beijing. Fresh material was preserved in 95% ethanol in the field, then deposited at -20 °C refrigerator for long preservation. The body length of the amphipod was recorded by holding the specimen straight and measuring the distance along the dorsal side of the body from the base of the first antenna to the base of the telson. Appendages were drawn using a Leica DM2500 compound microscope equipped with a drawing tube.

The lateral view of specimen was observed with a Hitachi S-3000N scanning electron microscope (SEM), the eyes are invisible for SEM pictures (Fig. 1).

3 Taxonomy

Gammarus praecipuus sp. nov. (Figs 1–56)

Holotype male (IZCAS-I-A1151-1), 11.7 mm, from a cave in Zangwangzhai Village (32° 03' N, 104° 88' E), Xinchun Town, Jiangyou City, Sichuan Province, China, 12 May 2010, collected by LIN Yu-Cheng. Paratypes: 2 males (IZCAS-I-A1151-3 and IZCAS-I-A1151-4), 2 females (IZCAS-I-A1151-2 and IZCAS-I-A1151-5), all same data as holotype.

Etymology. The specific name is from Latin *praecipuus* (peculiar), in reference to the peculiarity in troglobite characters such as outer plate of maxilla 1 with more serrated apical spines (>20) than common *Gammarus* species (11), and both rami of uropod 1 bare; adjective.

Diagnosis. Eyes absent; outer plate of maxilla 1 with 31 robust serrated apical spines, article 2 of right

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Fig. 1. Lateral view for *Gammarus praeceps* sp. nov.
Scale bar = 2 mm.

palm with 6 slender spines; calceoli present; both rami of uropod 1 bare; inner ramus of uropod 3 reaching 0.5 times the length of outer ramus; epimeral plates 2 and 3 with 3 spines on anteroventral margins, posterodistal corners blunt; urosomites 1–3 with groups of spines and setae.

Holotype male 11.7 mm.

Head (Fig. 2). Eyes absent, inferior antennal sinus deep.

Antenna 1 (Figs 3–4). Peduncular articles 1–3 in length ratio 1.0:0.7:0.5, with setae on distal corner; flagellum with 25 articles, articles 2–23 with aesthetascs; accessory flagellum with 4 articles; both primary and accessory flagella with short distal setae.

Antenna 2 (Figs 5–6). About 0.7 times as long as antenna 1, length ratio of peduncular articles 3–5 in 1.0:3.1:2.5, peduncular articles 4–5 with clusters of lateral and medial setae; flagellum with 12 articles and 1 tiny distal article, set with setae along ventral margins; calceoli present in articles 2–7.

Upper lip (Fig. 7). Ventral margin rounded, bearing minute setae.

Mandible (Figs 9–10). Left mandible incisor with 5 teeth; lacinia mobilis with 4 teeth, with 8 pairs of plumose setae along ventral margin; palp articles 1–3 in length ratio 1.0:2.1:1.7; article 2 armed with 10 marginal setae; article 3 with 3 A-setae, 2 groups of B-setae, 13 D-setae and 3 E-setae apically; incisor of right mandible with 4 teeth, lacinia mobilis bifurcate, with small teeth.

Lower lip (Fig. 8). Inner lobes lacking, outer lobes covered with thin setae.

Maxilla 1 (Figs 11–12). Asymmetrical, left inner plate with 17 plumose setae on medial margin; outer plate with 31 robust serrated apical spines, each spine with small teeth; article 2 of palp with 6 slender spines apically; article 2 of right palp with 6 slender

spines.

Maxilla 2 (Fig. 13). Inner plate with 13 plumose facial setae in an oblique row; inner and outer plates with long setae apically.

Maxilliped (Fig. 14). Inner plate with 3 stout apical and 1 subapical spine, some plumose setae along ventral margin; outer plate bearing a row of blade spines and 4 plumose setae apically; palp article 4 hooked, with a group of setae at hinge of unguis.

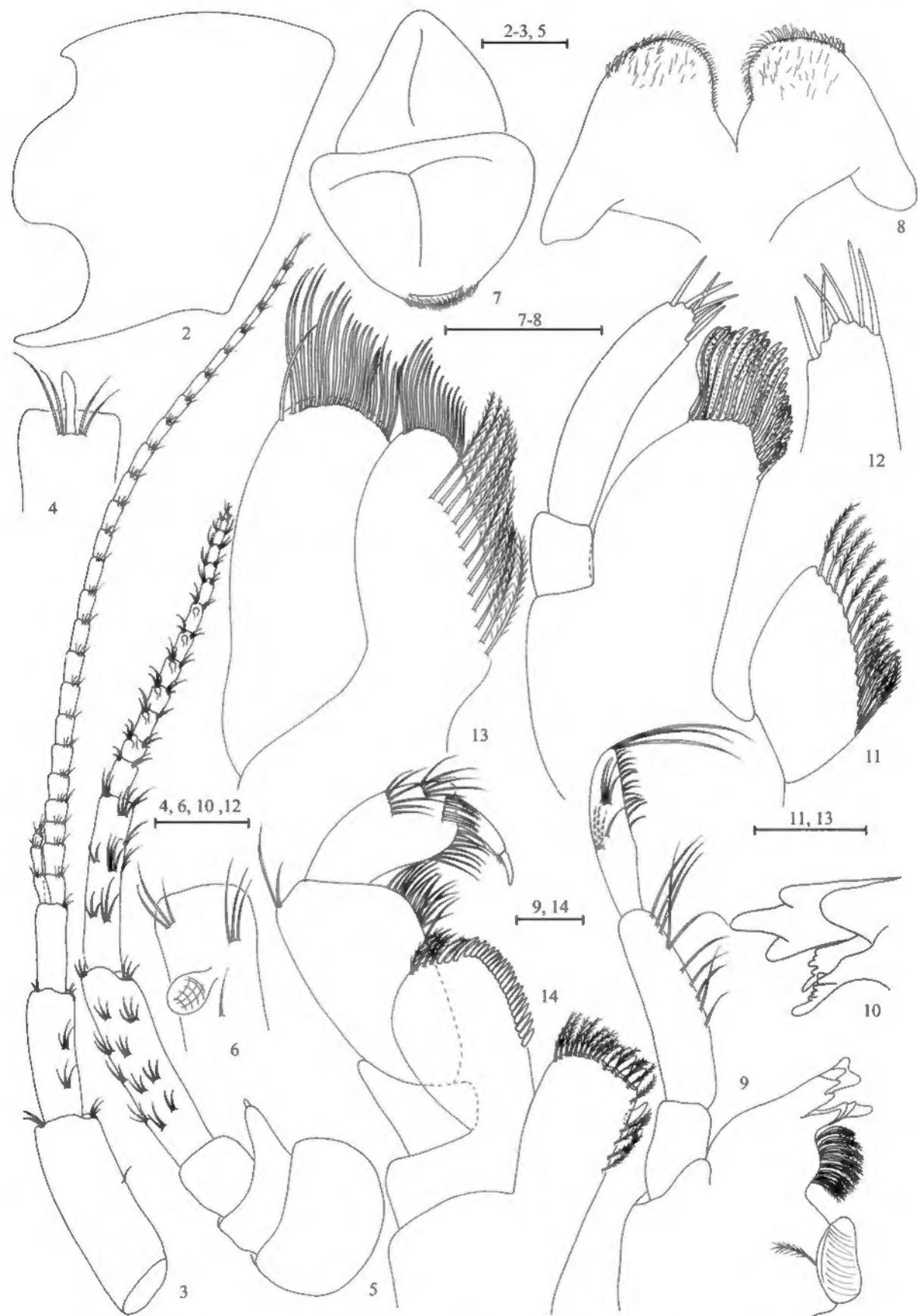
Gnathopod 1 (Figs 15, 17). Coxal plate bearing 2 setae and 1 seta on anterior and posterior margins, respectively; basis with setae on anterior and posterior margins; carpus as long as wide, about 0.5 times as long as propodus, posterior margin bearing short setae; propodus oval, palm margin evenly with 2 medial spines and 13 spines on posterior margin and facial surface.

Gnathopod 2 (Figs 16, 18). Coxal plate bearing 3 setae and 2 setae on anterior and posterior margins; basis with setae on anterior and posterior margins, posterodistal corner with short setae; carpus 1.2 times as long as wide, about 0.6 times as long as propodus, with parallel margins, bearing 5 clusters of setae along ventral margin; propodus palm ovate, palm margin evenly with 2 median spines and 6 spines on posterodistal corner.

Pereopod 3 (Figs 22, 27). Coxal plate bearing 2 setae and 1 seta on anteroventral and posterior margins; basis elongate, with setae along posterior margin; merus set with 6 clusters of short setae on posterior margin and 2 clusters of single spine accompanied by setae on anterior margin; carpus and propodus with groups of spines accompanied by short setae on posterior margin; dactylus with 1 plumose seta on posterior margin, and 2 setae at hinge of unguis.

Pereopod 4 (Figs 23, 28). Coxal plate excavated, bearing 2 setae on anterior margin and 6 setae on posterior margin; basis with setae along posterior margin; merus set with 4 clusters of setae on posterior margin and 1 spine on anterior margin, anterodistal with 1 spine accompanied by some setae; carpus and propodus with groups of spines accompanied by short setae on posterior margin; dactylus with 1 plumose seta on anterior margin, and 2 setae at hinge of unguis.

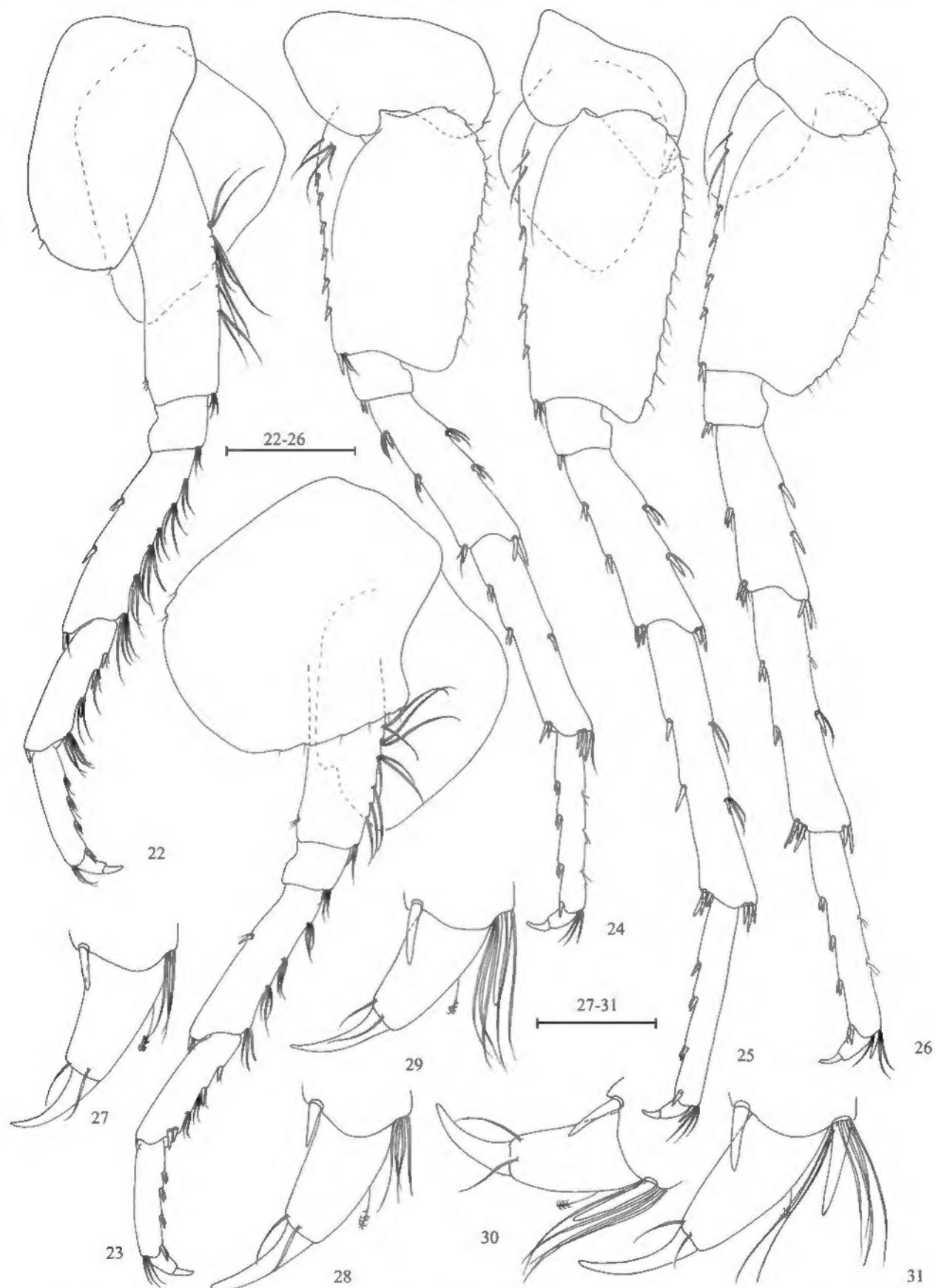
Pereopod 5 (Figs 24, 29). Coxal plate bearing 1 seta on anterior margin and 2 setae on posterior margin; basis with 4 setae and 6 spines on anterior margin, anterodistal corner with 1 spine accompanied by some setae, posterior margin with a row of 15 setae; merus to propodus with groups of spines accompanied by setae on anterior margin, and propodus with 3 groups of setae on posterior margin; dactylus with 1 plumose seta on posterior margin, and



Figs 2-14. *Gammarus praecipitus* sp. nov., holotype, male. 2. Head. 3. Antenna 1. 4. Aesthetascs of antenna 1. 5. Antenna 2. 6. Calceoli of antenna 2. 7. Upper lip. 8. Lower lip. 9. Left mandible. 10. Incisor of right mandible. 11. Maxilla 1. 12. Palp of right maxilla 1. 13. Maxilla 2. 14. Maxilliped. Scale bars: 2-3, 5, 7-8 = 0.5 mm; 4, 6, 9-10, 12, 14 = 0.1 mm; 11, 13 = 0.2 mm.



Figs 15 – 21. *Gammarus praecipitus* sp. nov., holotype, male. 15. Gnathopod 1. 16. Gnathopod 2. 17. Propodus of gnathopod 1. 18. Propodus of gnathopod 2. 19. Epimeral plate 1. 20. Epimeral plate 2. 21. Epimeral plate 3. Scale bars: 15 – 16, 19 – 21 = 1 mm; 17 – 18 = 0.5 mm.



Figs 22–31. *Gammarus praecipitus* sp. nov., holotype, male. 22. Pereopod 3. 23. Pereopod 4. 24. Pereopod 5. 25. Pereopod 6. 26. Pereopod 7. 27. Dactylus of pereopod 3. 28. Dactylus of pereopod 4. 29. Dactylus of pereopod 5. 30. Dactylus of pereopod 6. 31. Dactylus of pereopod 7. Scale bars: 22–26 = 1 mm, 27–31 = 0.2 mm.

2 setae at hinge of unguis.

Pereopod 6 (Figs 25, 30). Coxal plate bearing 2 setae on posterior margin; basis elongate, with 2 setae and 4 spines on anterior margin, anterodistal corner with 1 spine, posterior margin dwindling distally, with a row of 15 setae; merus to propodus with groups of spines on anterior margin; dactylus with 1 plumose seta on posterior margin, and 2 setae at hinge of unguis.

Pereopod 7 (Figs 26, 31). Coxal plate bearing 3 setae on posterior margin; basis expanded, posterior margin weakly narrowed distally, anterior margin with 2 setae and 4 spines, posterior with a row of 19 setae; merus to propodus with groups of spines on anterior margin, and propodus with 2 groups of setae on posterior margin; dactylus with 1 plumose seta on posterior margin, and 2 setae at hinge of unguis.

Coxal gills. Coxal gill of gnathopod 2 and gills of pereopods 3–5 a little shorter than bases; gill of pereopod 6 more than half length of basis; gill of pereopod 7 smallest, less than half of basis.

Epimeral plates (Figs 19–21). Plate 1 ventrally rounded, bearing 5 setae on anteroventral margin and 3 setae on posterior margin; plate 2 with 2 setae on anterior margin, 3 spines on ventral margin and 7 setae on posterior margin, posterodistal corner blunt; plate 3 with 3 spines on ventral margin, and 5 setae on posterior margin, posterodistal corner blunt.

Pleopods 1–3 (Figs 33–35). Similar, peduncles with 2 retinacula accompanied by 1 seta; outer ramus slightly shorter than inner ramus, both rami fringed with plumose setae.

Urosomites 1–3 (Fig. 32). Dorsally flat. Urosomite 1 with 2 groups of setae on dorsal margin and 2 spines accompanied by 2 setae on each side. Urosomite 2 with 2-1-1-2 spines accompanied by setae on dorsal margin. Urosomite 3 with 2 groups of setae on dorsal margin and 1 spine accompanied by 1 seta on each side.

Uropods 1–3 (Figs 36–38). Uropod 1 peduncle with 1 basofacial spine, with 2 spines on outer margin, 2 and 1 spine on outer and inner distal corners, respectively; both rami bare on later margins, with 5 terminal spines. Uropod 2 short, peduncle with 1 distal spine on each corner; inner ramus with 1 spine on inner margin; outer ramus bare, both rami with 5 terminal spines. Uropod 3 peduncle with 3 setae on surface and 6 distal spines; inner ramus about 1.1 times as long as peduncle, reaching 0.5 times the length of outer ramus, bearing 1 apical spine accompanied by simple setae; article 1 of outer ramus with 2 pairs of spines on outer margin; both margins set with plumose setae and few simple setae; terminal article shorter than adjacent spines.

Telson (Fig. 39). Deeply cleft, 0.9 times as

long as wide, both lobes with setae on dorsolateral margins, bearing 2 apical spines accompanied by 3 setae.

Paratype (IZCAS-I-A1151-2), 8.3 mm.

Gnathopod 1 (Figs 43, 45). Coxal plate bearing 2 setae and 1 seta on anterior and posterior margins, respectively; basis with setae on anterior and posterior margins; propodus oval, palm with 9 spines on posterior margin; dactylus with 1 seta on outer margin.

Gnathopod 2 (Figs 44, 46). Coxal plate bearing 3 setae and 1 seta on anterior and posterior margins; basis with setae on anterior and posterior margins, posterodistal corner with short setae; propodus subrectangular, palm margin with 4 spines on posterodistal corner, bearing simple setae along anterior and posterior margins; dactylus with 1 seta on outer margin.

Pereopods 3–4 (Figs 47–48). With longer setae on posterior margin than those of male.

Pereopods 5–7 (Figs 49–51). Similar to those of male.

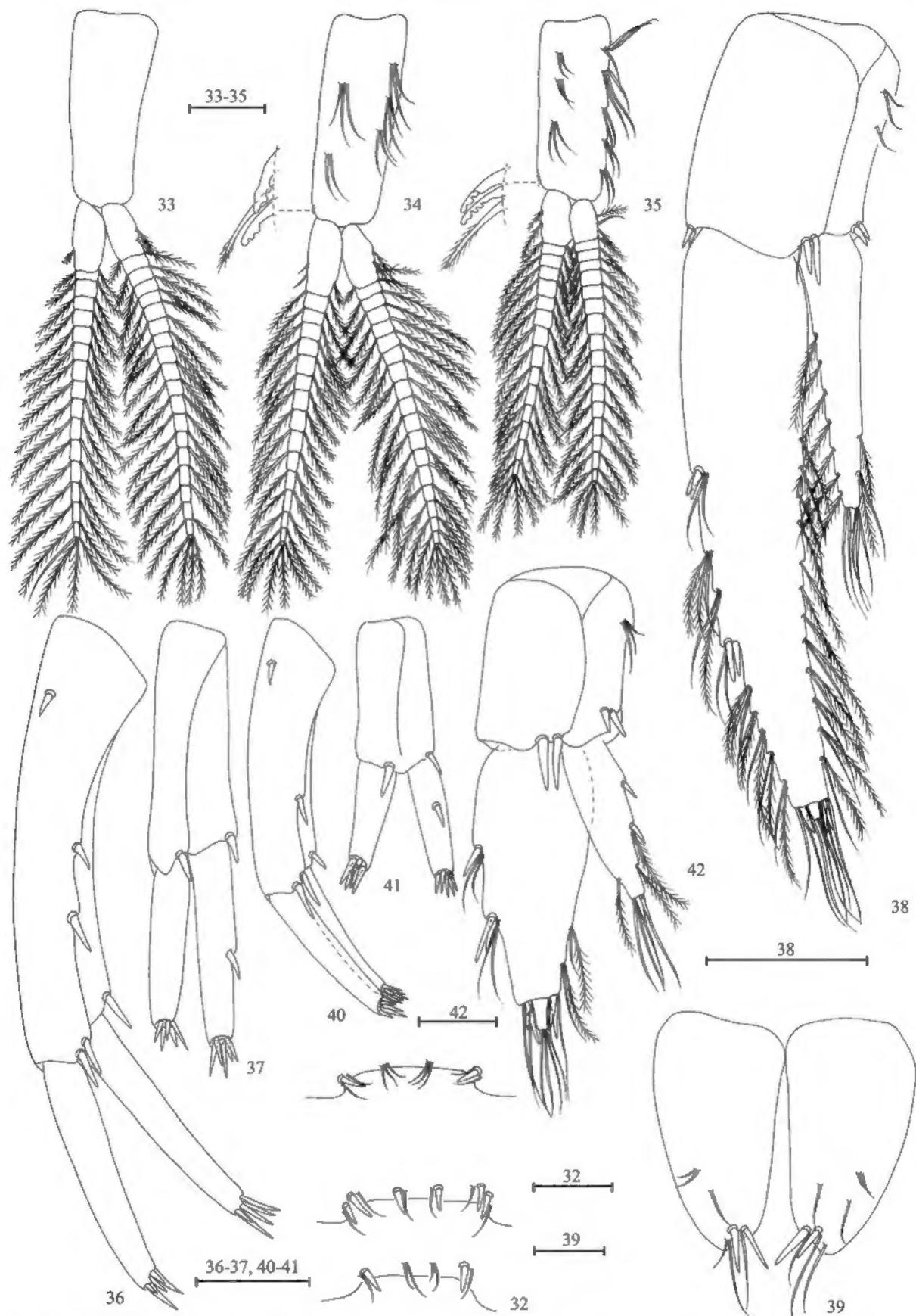
Uropod 1–3 (Figs 40–42). Uropods 1 and 2 are similar to those of male. Uropod 3 peduncle with 3 setae on surface and 4 distal spines; inner ramus 0.9 times as long as peduncle, reaching 0.5 times the length of outer ramus, with 2 spines and some plumose setae on lateral margin; article 1 of outer ramus stout, with a single and a pair of spines accompanied by simple setae on outer margin; terminal article shorter than adjacent spines.

Telson (Fig. 52). Left lobe with 1 apical spine accompanied by 2 setae; right lobe with 3 setae on surface.

Oostegite (Figs 53–56). Oostegite of gnathopod 2 broad, with marginal setae, oostegite of pereopods 3 and 4 elongate, oostegite of pereopod 5 smallest.

Remark. *Gammarus praecipuus* sp. nov. is similar to *G. xiansengensis* Hou et Li, 2002 in: eyes absent; calceoli present; pereopods 3–7 with fewer setae on posterior margins; article 2 of outer ramus of uropod 3 shorter than adjacent spines; urosomites 1–3 with spines and setae. The new species can be distinguished from *G. xiansengensis* by the following characters (*G. xiansengensis* in parentheses): outer plate of maxilla 1 with 31 robust serrated apical spines (with 11 robust serrated apical spines); inner ramus of uropod 3 reaching 0.5 times the length of outer ramus (reaching 0.9 times the length of outer ramus); epimeral plates 2–3 with 3 spines on ventral margins, posterodistal corners blunt (with 5 spines on each plate; posterodistal corners subacute).

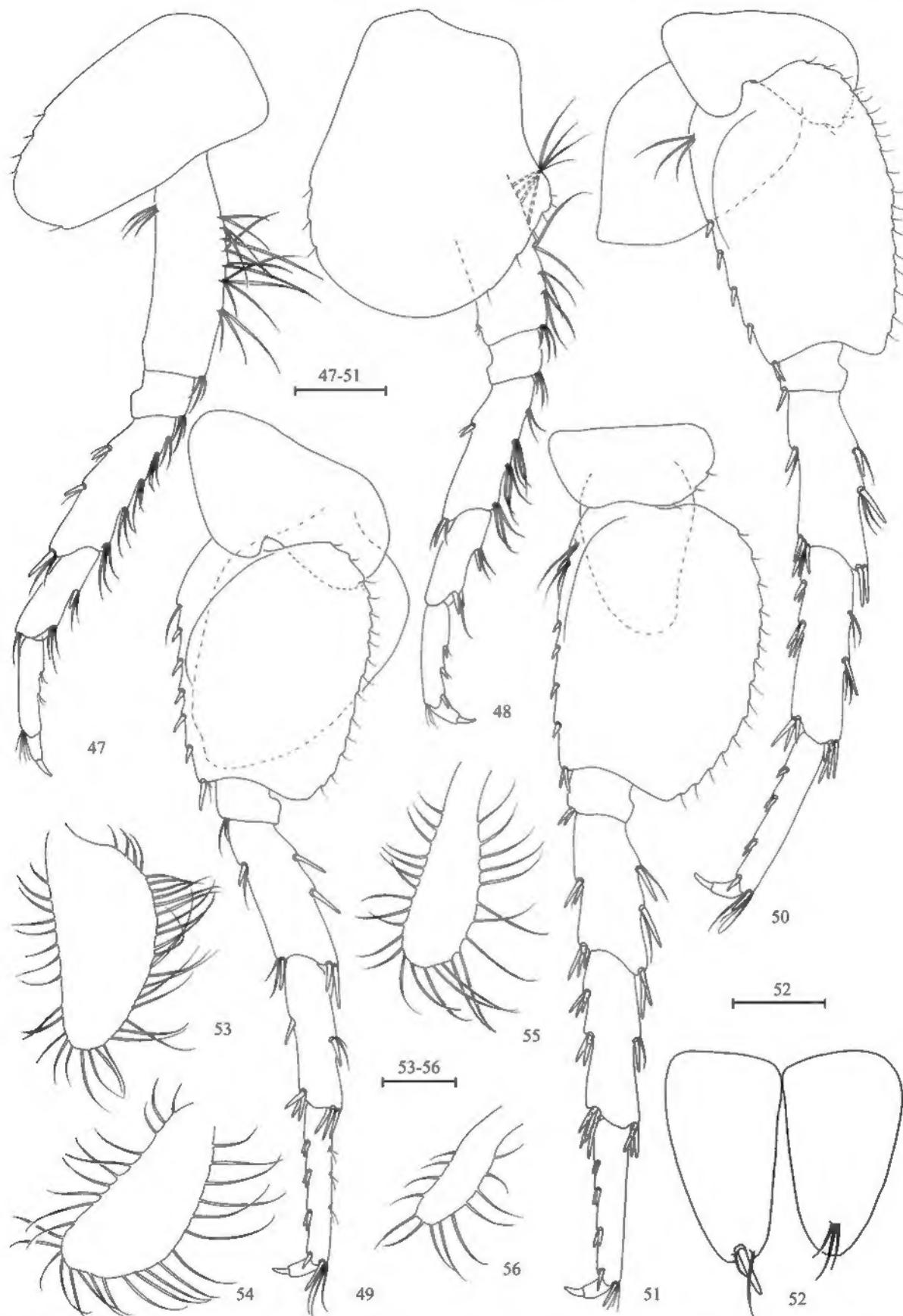
The new species can be distinguished from *G. lichuanensis* Hou et Li, 2002 by the following characters (*G. lichuanensis* in parentheses): outer plate of maxilla



Figs 32–42. *Gammarus praecipitus* sp. nov. 32–39. Male. 40–42. Female. 32. Urosomites, dorsal view. 33. Pleopod 1. 34. Pleopod 2. 35. Pleopod 3. 36, 40. Uropod 1. 37, 41. Uropod 2. 38, 42. Uropod 3. 39. Telson. Scale bars: 32–38, 40–41 = 0.5 mm; 39, 42 = 0.2 mm.



Figs 43 – 46. *Gammarus praecipitus* sp. nov., paratype, female. 43. Gnathopod 1. 44. Gnathopod 2. 45. Propodus of gnathopod 1. 46. Propodus of gnathopod 2. Scale bars: 43 – 44 = 0.5 mm, 45 – 46 = 0.2 mm.



Figs 47 - 56. *Gammarus praecipitus* sp. nov., paratype, female. 47. Pereopod 3. 48. Pereopod 4. 49. Pereopod 5. 50. Pereopod 6. 51. Pereopod 7. 52. Telson. 53. Oostegite of gnathopod 2. 54. Oostegite of pereopod 3. 55. Oostegite of pereopod 4. 56. Oostegite of pereopod 5. Scale bars: 47 - 51, 53 - 56 = 0.5 mm; 52 = 0.2 mm.

1 with 31 serrated apical spines (with 11 serrated apical spines); antenna 1 with 25 articles (with 43 articles); calceoli present (absent); inner ramus of uropod 3 reaching 0.5 times the length of outer ramus (reaching 0.9 times the length of outer ramus); epimeral plates 2 and 3 with 3 spines on ventral margins, posterodistal corners blunt (few setae and spines, posterodistal corners acute).

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中国四川省洞穴钩虾属一新种（甲壳纲，端足目，钩虾科）

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摘要 记述采自中国四川省洞穴钩虾属1新种，奇异钩虾 *Gammarus praecipitus* sp. nov. (图1~56)。新种与钩虾属其它物种的区别在于：眼睛缺失；第1小颚外叶具有31个齿，明显多于其它钩虾属物种的11个齿；第1尾肢内、外肢无侧刺或毛；第3尾肢内肢为外肢长的一半。

正模♂；副模：2♂♂，2♀♀，四川省江油市新春乡藏

关键词 分类，电镜扫描，比较，中国西南。

中图分类号 Q959.223.57

王寨无名洞，2010年5月12日，林玉成采。模式标本保存在中国科学院动物研究所。

词源：新种种名源自该种具有特殊的洞穴特征，如第1小颚外叶具多个齿以及第1尾肢内、外肢无侧刺或毛；形容词。

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